EFFECT OF INTERNAL LOAD ON CREATIVITY OF TACTICAL ACTIONS IN ELITE YOUTH FOOTBALL PLAYERS

By

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PH2016-90

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SYNOPSIS

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CERTIFICATE

I hereby declare that the synopsis **"Effect of Internal Load On Creativity Of Tactical Actions In Elite Youth Football Players"** being submitted in partial fulfilment of the requirement for the degree of Doctor of Philosophy in Physical Education under the Department of Exercise Physiology of Lakshmibai National Institute of Physical Education, Gwalior during the academic year 2022-23.

It is a bonafide record of original work carried out under the supervision of Dr. Deepak Sharma and co-guide Dr. Narendra Gangwar and has not been submitted in full or part to any other university or institute for a degree or diploma.

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TABLE OF CONTENTS

(i) Title Page

(ii) Table of Contents

(iii) Chapter – I (Introduction)

a) Brief introduction of the topic

b) Statement of the problem

c) Research Question

d) Objectives of the study

e) Hypothesis

f) Delimitations

g) Limitations

h) Definition and explanation of the terms

i) Significance of the study

(iv) Chapter II (Review of Related Literature)

(v) Chapter III (Research Methodology)

a) Selection of subjects

b) Selection of variables

c) Criterion measures

d) Administration of tests

e) Collection of data

f) Statistical technique to employed in the study

(vi) References

ABSTRACT

Football is a body contact, team invasion sport which involves quick decision making under high levels of exertion, both physical as well as psychological. With increasing demands of the game and improving physiological capabilities of the players, very narrow differences are evident in the modern games. While all the components such as Technical, Tactical, Physical, Psychological, and Social which affect the game are well categorised, studied, and trained to gain the slightest of advantages, creativity has emerged as the crux of modern training methodologies. It is critical to understand how these components affect creative behaviour on the field so that training can be further optimized. Thus, this study aims to understand the relationship between creative-tactical actions and physical load using standardized field-based methodologies like FUT-SAT. Elite youth football players will be selected to maintain objectivity and reliability of the results. And to measure creative-tactical behaviour in football under various physical load conditions their performance will be compared using repeated measures ANOVA. The result might add another perspective to training, rendering it more effective.

Chapter – I

“Playing football is very simple, but playing simple is the hardest thing there is”

- Johan Cruyff.

Football has come a long way since its trivial inception with the formalisation of the first set of rules called as the Laws of the Game in 1863 by the English FA (IFAB, 2023). Wilson, J. (2010) drew a comprehensive picture of this morphing scenario in his book, ‘Inverting the Pyramid’. He mentions how the systems of play have evolved and new tactical formations and roles were invented by the visionary coaches of their respective times. One notable difference between today’s modern football and that of the yesteryears is the level of compactness. The technical report on Russia World Cup also confirms this as the range of compactness for all the teams while out of possession was found to be between 435 m^2 to 681 m^2 (TSGR FIFA, 2018). Such diminishingly tight areas do not allow much time for the teams in possession, thus making it difficult for them to devise and launch an organized attack. As a result, often players find themselves in unexpected situations unlike seen during training and are required to rely on their instinctive thoughts and actions about the situation both individually and collectively to make the best out of it. Hence player’s individual and collective creativity has a crucial role to succeed in modern football.

Creativity

It is generally defined as something novel and useful. However, such a definition makes it very hard to operationalize and measure. In order to solve this problem researchers in their studies such as Fardilha & Allen, (2020); Kanlı (2020); and Zahno & Hossner, (2020) have begun to explore other perspectives of

understanding creativity. To solve the operationalization issue, it is advocated to see it as useful in domain specific terms and could be understood as a function of either the Person, the Product, or the Process itself.

Creative Actions V/S Creative Thought

With the understanding of domain specific context of creativity, the look of it in the context of football instantly becomes more about action rather than just a mere thought. Because in sports the complexity of actions and their outcomes decide quality. Thus the video based assessment of Divergent and Convergent Abilities arguably does not correlate very well with actual game performances (Zahno & Hossner, 2020). Creative thought is the idea of new and varied solutions a player would be able to think but creative actions is the solution that he would have to perform instantaneously and that too under the constrains of the opponent, time, space, rules and the ball itself as it needs to be kept under control. Moreover, the dynamics of the game keeps on changing which demands of the player to quickly adjust his thoughts and actions accordingly to the next best solution. Another component in the mix is the level of exertion that a game of football exerts.

Exertion in Football

Football is an intermittent sport. Players work very close to their anaerobic zones often jump in and out of it too. Coelho et al. (2011) in their study classified player positions based on the time they spent in various intensity zones. They found that Wing Backs spent the most time out of all positions in zone five followed by Forwards and Midfielders did not enter as much into the highest zone as wing backs and forwards. This is interesting as midfielders connects all the players while being

surrounded on all sides and are entrusted with the role of doing the creative work of playmaking. It is often observed that playmakers are exempted from erratic running roles including dedicated defensive roles. Also, technical teams like to control the pace of the game. Keep the tempo under check (Kempe et al., 2014). Also under the effect of fatigue players with better decision making ability tend to reduce their intensity and external load dynamics to effectively control tempo (Dambroz & Teoldo, 2023).

Fatigue and Creativity

At the core, creativity is a cognitive process, and Abd-Elfattah et al. (2015) discovered that there exist an inverted U relationship between the two. This suggests that acute exercise intensities might affect this cognitive function and in turn creativity and tactical creative actions. If we are talking about creative actions then the effect of fatigue on neuromuscular functions may also be adverse. With this knowledge looking at the modern trends of football which is becoming increasingly taxing on the brain with its emphasis on tactics and positional plays as evident with the new ways of training methodology such as tactical periodization (Bordonau & Villanueva, 2018), it only begs the question to analyse this relationship and better understand natural behavior of controlling of play by the tactically better teams.

Statement of the Problem

Effect of internal load on creativity of tactical actions in elite youth football players.

Research Questions

- Is there a significant difference in Creative – Tactical Performance under different Heart Rate Intensity zones of elite youth football players?
- Is there a significant difference in quality of the Creative – Tactical Actions performed under aerobic versus anaerobic zones?
- What are the adjustments in external load dynamics and creative - tactical actions (frequency) in the period immediately following a period of high intensity?
- Is there a correlation between selected resting Heart Rate Variability measures and the creative – tactical performance at increasing levels of internal load?
- Whether player's rate of perceived exertion in each bout has any association with their frequency of positive creative – tactical actions?
- Is there an optimal level of internal load factor for creative – tactical performance?

Objectives of the Study

- To record each Player's resting (selected) HRV measures of the day of testing.
- To calculate the intensity zones of each player as the % of their HR max.
- To conduct, record and score each tactical action of all the players individually.
- To record the HR values in real time.
- To record the DFA – alpha values in real time.
- To classify the creative – tactical actions into separate HR intensity zones.
- To classify the creative – tactical actions into aerobic and anaerobic zones.
- To measure the changes in external load dynamics at different intensity zones.

- To calculate the frequency of positive creative – tactical actions at different intensity zones.
- To collect the rate of perceived exertion of the players.

Hypothesis

On the basis of literatures reviewed, available research findings, expert opinions, and researcher's own understanding of the problem, it is hypothesized that:

H_1: There will a significant difference in creative – tactical performance in different intensity zones.

H_2: There will be a significant difference between the quality of creative – tactical actions performed under aerobic and anaerobic zones.

H_3: There will be a significant difference in external load dynamics under different intensity zones.

H_4: There will be a positive correlation between selected Heart Rate Variability values and Creative – Tactical Performance.

H_5: Rate of perceived exertion of players will be negatively correlated with their frequency of positive creative – tactical actions.

H_6: There exists an optimum level of internal load measures that facilitate creative – tactical behaviour.

Delimitations

Since the study is conceptualized for the purpose of examining the creative – tactical performance of footballers, it requires a fair amount of consistency in performance of the players for the findings to be valid. Keeping the essential requirements and feasibility in mind the researcher has confined the study within the following area:

1. The study will be delimited to 30 Indian footballers.
2. It will be further delimited to elite youth football players,
3. Further delimited to male football players,
4. Further delimited to players between the ages of 16 to 20 years,
5. Further delimited to field-based assessment of football creativity,
6. Further delimited to the use of Small Sided Games (SSG).

Limitations

1. Researcher cannot control for Sufficient sleep of the participants prior to the testing days. Sleep deprivation is known to have an effect on focus and attentional abilities which in turn can affect creative – tactical performance.
2. Researcher also cannot control the participant's motivation levels and effort during the field testing for passing ability.
3. Further the researcher cannot ensure a uniform pre-meal for all the players which might lead to uneven energy levels, resulting to early fatigue in some.

Definition and explanation of the terms

Creativity: To produce something novel and useful according to the domain.

Creative – Tactical Actions: Individual actions of the footballer on the pitch both in and out of possession.

Creative – Tactical Performance: The sum of all the creative tactical actions performed by a player on the field (during play).

Positive – Creative – Tactical Actions: Creative tactical actions that lead helps a team to gain ground and get nearer to the opponent's goal.

Small Sided Games: Any game format smaller than the official 11 – a – side game.

Internal Load Dynamics: Internal load measures

Significance of the Study

This study will attempt to associate internal load due to exertion and creative – tactical performance in football. It will be tested in an ecological manner to so that the findings can be directly applied on field. The use of small sided games as dynamic tools in modern day football periodization is gaining momentum with each passing day. Intensity being a key aspect of such SSGs, this study may contribute in the following ways:

1. The finding of the study might add to the body of knowledge related to training for creativity in football.
2. The result of the study might support the rationale of optimum intensity to facilitate creative behaviour in footballers.
3. The result of this study might add another facet to the coach's and athlete's comprehension related to creative tactical performances.
4. The success of the study can be a valuable addition in favour of methodical quality of applying SSGs in a more relevant way.
5. The result of the study might add new knowledge to the research field related to football coaching methodology.
6. The findings of the study will enlighten the coaches about the physiological importance behind a naturally occurring behaviour of tempo control.
7. The result of this study can support the process of talent identification.
8. The outcome of the study might help coaches to design SSGs for tactical sessions with optimum intensity and volume.
9. Team tactics and strategy can be better balanced with the found knowledge to facilitate creative behaviour.

Chapter II

Review of related literature

Defining Creativity

Kanlı (2020) *Aim:* The aim of this book section was to present a brief overview on assessment of creativity and discusses the strengths and weakness of various instruments used for the purpose. *Conclusions:* Creativity is generally defined as the ability to produce work that is novel and appropriate. It is a multifaceted phenomenon which is difficult to define and operationalize. Such hurdles can be overcome by firstly giving importance to the usefulness of the higher order cognitive constructs. In a content analysis done for the articles published in two major creativity research journals, Creativity Research Journal and Journal of Creative Behavior respectively, researchers found that only 34% of the selected articles provided and explicit definition on creativity. In order to examine a concept scientifically, we should rely on operationalized definitions and the relatively low rates of explicit definition on creativity, constitutes a major problem for the field. The author also presented with an operationalized definition of creativity as follows, "the interaction among aptitude, process, and environment by which an individual or group produces a perceptible product that is both novel and useful as defined within a social context".

Zahno & Hossner (2020) *Aim:* The goal of this systematic review was to streamline the thoughts and ideas related to creativity in sports thus facilitating the development of a unified theory for sports practice. *Methods:* 38 studies were presented and characterized in terms of their underlying conceptualizations and measures of creativity. *Results:* The study found that, in most cases, creativity was

conceptualized as a player's domain-specific divergent thinking (DT) ability, reflected by individual differences in the number, variety and originality of ideas they were able to generate in response to game situations. Empirical studies indicated that DT could be improved by practice. However, the critical assumption developed was that, the transfer of enhanced DT ability to creative on-field actions, needs further testing. *Conclusion:* In line with relational understanding of creativity and a functional approach to behavioral control, for sports practice, a conceptual re-orientation was proposed that, rather than seeking ways to improve players' DT ability, to target sensorimotor skills that allow players to perform a variety of task-solutions and thus to act less predictably to the opponent—or in other words, more creative.

Importance of Creativity

Li & Zhao (2021) *Aim:* The objective of the study was to compare goal scoring patterns among the "Big Five" European football leagues during the 2009/2010–2018/2019 seasons. *Method:* A total of 18 pattern dimensions related to the offense pattern, the shooting situation and the scoring time period were evaluated. Kruskal–Wallis analyses revealed significant pattern differences among the five leagues. *Results:* The Spanish La Liga showed a greater proportion of goals from throw-ins. The English Premier League had a higher tendency to score from corner kicks. The German Bundesliga had the greatest number of goals from counterattacks and indirect free kicks, and the Italian Serie A had the greatest proportion of penalties. Ligue 1's scoring ability is weaker than that of the other leagues, especially Bundesliga. The Bundesliga had an overwhelming advantage in goals scored on big chances with assists, while the Premier League had an advantage in goals scored with assists that were not from big chances. However, the differences among the five leagues in the

mean goals scored in the last 15 min and the goals from elaborate attacks and direct free kicks were not statistically significant. *Conclusions:* These results provide a valuable addition to the knowledge of different goal patterns of each league and allow us to better

understand the differences among the leagues.

Kempe et al. (2014) *Aim:* This study introduces a new index (Index of Offensive Behavior, IOB) that combines different variables of offensive actions to evaluate tactical behavior. *Methods:* To evaluate the indexes data of 676 official games (German Bundesliga 2009/10, & 2010/11, FIFA World Cup 2010) were analysed using the "MathBall"- notation software (Algorithma Ltd., 2009). *Results:* IOB was able to reliably distinguish the two common tactical approaches in soccer: possession and direct play. *Conclusion:* It showed that successful teams prefer possession play and that game control (measured via Index of Game Control, IOC) is the most important variable of success irrespective of the tactical approach.

Kempe & Memmert (2018) *Aim:* This study investigated the level of creativity of goals scored in football. *Methods:* All goals in the Football FIFA World Cup 2010 and 2014, as well as the Football UEFA Euro 2016 were qualitatively examined. Three Football experts evaluated the last eight actions before each goal using a creativity scale ranging from 0 to 10 (0 = not creative, 10 = highly creative) of all goals scored via open play (311 goals in 153 matches). Level of creativity was revealed using an Analysis of Variance and the frequency of high highly creative goals using a Kruskall- Wallis Test. *Results:* Closer the actions to a goal, the more creatively were they evaluated. Teams that advanced to the later rounds of the tournament demonstrated greater creativity than teams that failed to do so. High creativity in the last two actions before the actual shot on goal proved to be the best

predictor for game success. *Conclusion:* The study showed that creativity seems to be a factor for success in high level football. Thereby it provides an empirical basis for the ongoing debate on the importance of creativity training in football.

Assessment of Creativity

Fardilha & Allen (2020) *Aim:* The purpose of this paper was to conduct the first systematic narrative review of the literature on sporting creativity, critically synthesising 51 years of published research (1967–2018) and proposing avenues for future research. *Methods:* Six databases were used, and 48 documents met search criteria. The findings are organised in four categories: (a) defining creativity, (b) correlates of creativity, (c) assessing creativity and (d) developing creativity. *Conclusion:* Creativity definitions and assessments have privileged thought processes over the ability to act. A distinction is warranted between creativity about sport and creativity in sport (in action) and aligned assessment methods. The literature does not support a single strategy for the development of sporting creativity but does support its trainability. Evidence of the effectiveness of programmes for the enhancement of sporting creativity is growing but is still limited. Furthermore, while it is recognised that coaches have a pivotal role in the development of sporting creativity, research involving them is still scarce.

Memmert & Roth (2007) *Aim:* The study examined the efficacy of various training approaches in team ball sports for the development of tactical creativity. *Methods:* Altogether, 135 children aged about 7 years took part in a 15-month field-based study. They participated either in non-specific treatment groups, a specific handball, soccer or field hockey group, or a control group. General and game-oriented tactical creativity were chosen as outcome measures. *Results:* Analysis of treatment-related

effects showed that the non-specific groups displayed improvements in general creativity, whereas the specific groups showed improvements in the game-oriented creativity in which they were trained. Furthermore, clear transfer-related effects were observed. The analysis of group-related effects indicated no differences between the approaches. Only the soccer-specific group performed better in nearly all creative values. *Conclusion:* A non-specific concept appears to be a promising alternative to traditional specific treatments. This is further substantiated by several pedagogical, psychological, and medical arguments.

Teoldo da Costa, (2011) *Aim:* This study's goal was to evaluate tactical oriented game test situations for 12-13 year-old highly-talented soccer players and to analyze dynamic, intra-individual developments of the players. *Methods:* A cross-sectional design was carried in study 1, using game test situations to measure specific tactics and creative performance for 195 expert players. *Results:* Analysis from five evaluation criteria show that both diagnostic instruments can be used for recording football-specific creativity and game intelligence in talented young players. They produced tactical indicators that can be described as objective and valid, exhibit a sufficient degree of differentiation and are easy to record. Study 2 uses a longitudinal design to present a dynamic performance diagnostic tool for analyzing intra-individual improvements of German Soccer Foundation talents according to football-specific creativity and game intelligence. The results with respect to divergent tactical thinking clearly show that very different change processes were observed in the German Soccer Foundation players.

Torrents et al. (2016) *Aim:* The study determined, how the number of teammates and opponents affects the exploratory behaviour of both professional and amateur players

in small-sided soccer games. *Methods:* Twenty-two professional (age 25.6 ± 4.9 years) and 22 amateur (age 23.1 ± 0.7 years) male soccer players played three small-sided game formats (4 vs. 3, 4 vs. 5, and 4 vs. 7). These trials were video-recorded and a systematic observation instrument was used to notate the actions, which were subsequently analysed by means of a principal component analysis and the dynamic overlap order parameter (measure to identify the rate and breadth of exploratory behaviour on different time scales). *Results:* A higher the number of opponents required for more frequent ball controls. Moreover, with a higher number of teammates, there were more defensive actions focused on protecting the goal, with more players balancing. In relation to attack, an increase in the number of opponents produced a decrease in passing, driving and controlling actions, while an increase in the number of teammates led to more time being spent in attacking situations. A numerical advantage led to less exploratory behaviour, an effect that was especially clear when playing within a team of seven players against four opponents. All teams showed strong effects of the number of teammates on the exploratory behaviour when comparing 5 vs 7 or 3 vs 7 teammates. These results seem to be independent of the player's level.

Related to Fatigue in a Game of Football

Coelho et al. (2011) *Aim:* This study determined Brazilian soccer game intensity (GI) during official competitive matches and to compare GI among different player positions. *Methods:* Heart rate (HR) was measured in 26 under-17 (U-17) and 18 under-20 (U-20) soccer players (age 16.38 ± 0.5 and 18.24 ± 0.66 years, respectively) during 14 and 15 official games, respectively. Individual maximal heart rate (HRmax) and anaerobic threshold (AT) HR were evaluated in field tests. GI defined as

%HRmax was monitored considering five intensity zones ranging from 1 = < 70% HRmax to 5 = 95-100% HRmax. ***Results:*** Mean GI and AT intensity were 84.4 ± 5.1 and 86.3 ± 4.0% HRmax for the U-17 category and 84.1 ± 4.1 and 87.0 ± 5.1% HRmax for the U-20 category, respectively. Wingbacks (WB) spent more time in zone 5 than forwards (FW) ($p<0.05$). Midfielders (MF) spent more time in zone 3 than all other players and in zone 4 than defenders and FW ($p<0.05$). Mean GI and AT intensity were similar. WB performed more maximum effort than FW. MF did not participate as much in maximum effort as did WB and FW.

Mohr et al. (2005) *Aim:* This review describes when fatigue may develop during soccer games and the potential physiological mechanisms that cause fatigue in soccer. *Results:* According to time – motion analyses and performance measures during match-play, fatigue or reduced performance seems to occur at three different stages in the game: (1) after short-term intense periods in both halves; (2) in the initial phase of the second half; and (3) towards the end of the game. Temporary fatigue after periods of intense exercise in the game does not appear to be linked directly to muscle glycogen concentration, lactate accumulation, acidity or the breakdown of creatine phosphate. Instead, it may be related to disturbances in muscle ion homeostasis and an impaired excitation of the sarcolemma. Soccer players' ability to perform maximally is inhibited in the initial phase of the second half, which may be due to lower muscle temperatures compared with the end of the first half. Thus, when players perform low intensity activities in the interval between the two halves, both muscle temperature and performance are preserved. Several studies have shown that fatigue sets in towards the end of a game, which may be caused by low glycogen concentrations in a considerable number of individual muscle fibres. In a hot and humid environment, dehydration and a reduced cerebral function may also contribute to the deterioration

in performance. *Conclusion:* fatigue or impaired performance in soccer occurs during various phases in a game, and different physiological mechanisms appear to operate in different periods of a game.

Related to Effects of Physical Fatigue and Cognition

Abd-Elfattah et al. (2015) *Aim:* The goal of this review was to focus on the effect of fatigue on muscle activity, proprioception, and cognitive functions and to summarize the results to understand the influence of fatigue on these functions. *Conclusion:* Muscle fatigue causes decrease in muscle activation pattern, which in turn affects the joint sense of position leading to disturbed balance and an increase in the risks of falls. Furthermore, fatigue appears to have an effect on cognitive functions, regardless of the controversy found by research, it can be safely said that a relation does exist between the intensity and duration of physical activity and the cognitive function.

Dambroz & Teoldo (2023) *Aim:* The purpose of this study was to verify whether decision-making skills influence the tactical behavior and physical performance of soccer players under acute physical fatigue, assessed in an actual game-play. *Methods:* The sample was comprised of 24 trained soccer players (18.25 ± 1.48 years old) from two Brazilian clubs grouped into two categories with 12 players each (with high and low decision-making skills). The assessment of decision making, tactical behavior, and physical performance were carried out using TacticUP®, FUT-SAT, and GPSports® respectively. Acute physical fatigue was induced through the T-SAFT90 test. *Results* showed that under acute physical fatigue players with high decision-making skills maintained tactical behavior efficiency and had their paces reduced, in addition to displaying reduced total distance covered ($p < 0.001$), number of accelerations ($p < 0.001$), and decelerations ($p < 0.001$), and average movement speed

($p < 0.001$). On the other hand, players with low decision-making skills displayed reduced tactical behavior efficiency ($p = 0.002$) and maintained their movement pace under physical fatigue. *Conclusion:* Decision-making skills contribute to players' tactical behavior efficiency under acute physical fatigue, besides promoting reduced physical strain in movement actions throughout the field.

Related to Heart Rate Variability Measures

Shaffer & Ginsberg, (2017) *Aim:* This article briefly reviews current perspectives on the mechanisms that generate 24 h, short-term (~5 min), and ultra-short-term (<5 min) HRV, the importance of HRV, and its implications for health and performance. The authors provided an overview of widely-used HRV time-domain, frequency-domain, and non-linear metrics. Time-domain indices quantify the amount of HRV observed during monitoring periods that may range from ~2 min to 24 h. Frequency-domain values calculate the absolute or relative amount of signal energy within component bands. Non-linear measurements quantify the unpredictability and complexity of a series of IBIs. They stressed on the importance of measurement context, including recording period length, subject age, and sex, on baseline HRV values. They cautioned that 24 h, short-term, and ultra-short-term normative values are not interchangeable. The authors provided the overview of HRV assessment strategies for optimal performance interventions.

Shaffer & Ginsberg, (2017) *Aim:* This brief research report illustrates the potential merits of real-time monitoring of this metric for the purposes of aerobic threshold (AT) estimation and exercise intensity demarcation between low (zone 1) and moderate (zone 2) in a former Olympic triathlete. *Methods:* In a single-case feasibility study, three practically relevant scenarios were successfully evaluated in cycling, (1)

estimation of a HRV threshold (HRVT) as an adequate proxy for AT using Kubios HRV software via a typical cycling stage test, (2) estimation of the HRVT during real-time monitoring using a cycling 6min stage test, (3) a simulated 1 h training ride with enforcement of low intensity boundaries and real-time HRVT confirmation. *Results:* This single-case field evaluation illustrates the potential of an easy-to-use and low-cost real-time estimation of the aerobic threshold and exercise intensity distribution using fractal correlation properties of HRV. *Conclusion:* A non-linear heart rate variability (HRV) index based on fractal correlation properties called alpha1 of Detrended Fluctuation Analysis (DFA-alpha1), has been shown to change with endurance exercise intensity. Its unique advantage is that it provides information about current absolute exercise intensity without prior lactate or gas exchange testing. Therefore, real-time assessment of this metric during field conditions using a wearable monitoring device could directly provide a valuable exercise intensity distribution without prior laboratory testing for different applied field settings in endurance sports. Until of late no mobile based product could display DFA-alpha1 in real-time using off the shelf consumer products. Recently an app designed for iOS and Android devices, HRV Logger, was updated to assess DFA-alpha1 in real-time. Furthermore, this approach may enhance the translation of science into endurance sports practice for future real-world settings.

Related to Internal and External Load Measure Dynamics in SSGs

Clemente et al. (2019) *Aim:* The purpose of this study was twofold: (i) analyze the variations of internal and external load between intermittent regimens (6 × 3’ and 3 × 6’) during a small-sided game (SSG); and (ii) analyze the variations of internal and external load within-intermittent regimens (between sets). *Methods:* Ten male

amateur soccer players (age: 21.7 ± 2.1 years) participated in this study. *Results:* Almost certain large decreases in total distance (−8.6%, [−12.3; −4.8], Effect Size (ES): −1.51, [−2.20; −0.82]) and running distance (−34.0%, [47.0; −17.8], ES: −2.23, [−3.40; −1.05]) were observed when comparing the 3 × 6' and 6 × 3'. Very likely moderate and large decreases in total accelerations (−24.0%, [−35.1; −10.9]; ES: −1.11, [−1.75; −0.47]) and total of decelerations (−26.7%, [−38.8; −12.1]; ES:−1.49, [−2.36; −0.62]), respectively, were found when comparing the 3 × 6' and 6 × 3'. Very likely increases in rated of perceived exertion in the set 3 in comparison to the 1st during the 3 × 6' SSG (34.5%, [12.4; 61.0], ES: 1.35, [0.53; 2.16]) and the 6 × 3' (29.9%, [11.6; 51.2]; ES: 1.17, [0.49; 1.85]). *Conclusion:* Longer sets increase the perception of effort and contribute to a large decrease in total and running distances, and total of accelerations and decelerations. Meaningful decreases in time-motion demands occur between sets 2 and 3 while perceived effort increases.

Chapter III

METHODOLOGY

The following methodology and procedures are being considered by the researcher to successfully tackle the research problem.

Selection of the Subjects

30 male, elite youth level footballers will be purposively selected for the study. The players will be from the age bracket of 16 to 20 years.

Selection of Variables

Internal Load Variables:

1) Heart Rate Variability
2) Heart Rate in (Real Time)
3) DFA Alpha 1 (Real Time)
4) Rate of Perceived Exertion

External Load Variables:

1) Total Running Distance,
2) No. of High – Speed Runs,
3) High Speed Run Distance.

Creative Performance Variables:

1) General Creativity (Video Based), and
2) Creative Action/Performance Score (Field Based Assessment)

Criterion Measures

Physiological Variables:

The data of physiological variables will be collected through a portable chest-strap monitor Polar H10 (Polar Global)

1. Heart Rate Variability – will be measured in milli-seconds.
2. Root Mean Square of Successive Differences (RMSSD) – also in milli-seconds.
3. Heart Rate in (Real Time) – will be measured in Beats Per Minute.
4. DFA Alpha 1 (Real Time) – A mathematical value based on fractal correlation properties of HRV to be measured via HRV – Logger (Android App).

External Load Measures:

External load measures will be obtained through FIFA International Match Standards (IMS) Certified GPS Performance Trackers at minimum 10 Hz.

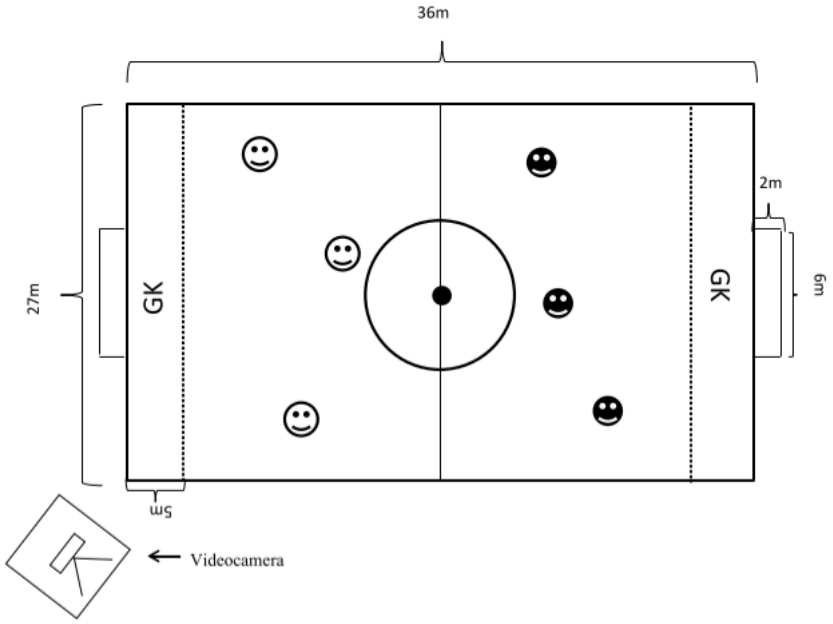
1. Total Running Distance – Will be measured in meters (m).
2. No. of High – Speed Runs – Will be obtained as a positive integer (n).
3. High Speed Run Distance – Will be obtained in meters (m).

Creative Performance Variables:

1. General Creativity (Video Based) – Will be obtained through Tactic UP Protocol which gives a tactical behavior score based on responses chosen by the participant after watching game situational video clips.
2. Creative Action/Performance Score (Field Based Assessment) – Recorded performance of each player in a Small Sided Game format will be assessed for every action on and off the ball and then averaged to get an overall score.

Administration of the Tests

The organization and procedure of the field-based tests is mentioned as under:



1) GK + 3 v 3 + GK (Teoldo da Costa, 2011):

Figure 1. The organization of GK + 3 v 3 +GK

2) Identification of Gaps (Memmert & Roth, 2007):

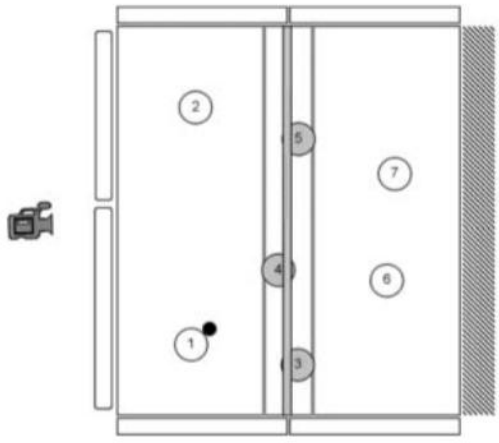


Figure 2. The organisation for the game test situation focusing on identifying the gaps.

3) Off the Ball Movement (Memmert & Roth, 2007):

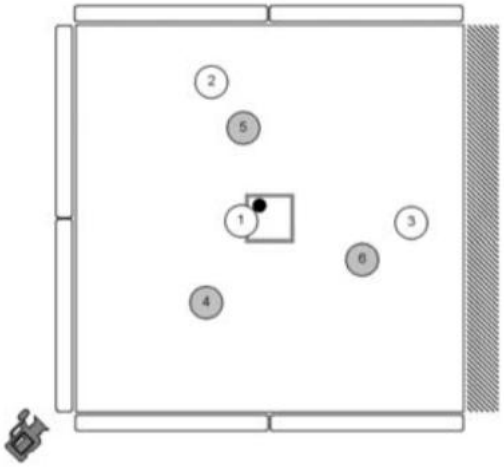


Figure 3. The organisation for the game test situation focusing on off the ball movement.

Collection of Data

Notational analysis is used to mark the creative - tactical actions of each players. One of the following methods of data collection and interpretation will be employed based on the availability and feasibility of the researcher, or an adopted method can also be scientifically developed if the necessity arises.

1) FUT – SAT Protocol with GK + 3v3 + GK (Teoldo da Costa, 2011):

- Tactical Performance Index (TPI) = $\frac{\Sigma \text{ Tactical Actions}(PP \times QP \times PA \times AO)}{\text{No. of Tactical Actions}}$

Where,

PP- Performance of Principle

QP- Quality of Principle Performance

PA- Place of Action on Game Field

AO- Action Outcome

Chart 1. Classification of Creative Tactical Actions as per FUT SAT.

Definitions, categories and sub-categories of variables assessed by FUT-SAT

Categories	Sub-Categories	Variables	Definitions
Tactical Principles	Offensive	Penetration	Movement of player with the ball towards the goal line.
		Offensive Coverage	Offensive supports to the player with the ball.
		Depth Mobility	Movement of players between the last defender and goal line.
		Width and Length	Movement of players to extend and use the effective play-space.
		Offensive Unity	Movement of the last line of defenders towards the offensive midfield, in order to support offensive actions of the teammates.
	Defensive	Delay	Actions to slow down the opponent's attempt to move forward with the ball.
		Defensive Coverage	Positioning of off-ball defenders behind the "delay" player, providing defensive support.
		Balance	Positioning of off-ball defenders in reaction to movements of attackers, trying to achieve the numerical stability or superiority in the opposition relationship.
		Concentration	Positioning of off-ball defenders to occupy vital spaces and protect the scoring area.
		Defensive Unity	Positioning of off-ball defenders to reduce the effective play-space of the opponents.
Place of Action	Offensive Midfield	Offensive Actions	Offensive actions performed in the offensive midfield.
		Defensive Actions	Defensive actions performed in the offensive midfield.
	Defensive Midfield	Offensive Actions	Offensive actions performed in the defensive midfield.
		Defensive Actions	Defensive actions performed in the defensive midfield.
Action Outcomes	Offensive	Shoot at goal	When a player shoots at goal, and (a) scores a goal, (b) the goalkeeper makes a save, (c) the ball touches one of the goalposts or the crossbar.
		Keep possession of the ball	When team players execute passes to each other and keep up with the ball.
		Earn a foul, win a corner or throw-in	When the match is stopped due to a foul, corner or throw-in; the team that was attacking KEEPS possession of the ball.
		Commit a foul, give away a corner or throw in	When the match is stopped due to a foul, corner or throw-in; the possession of the ball CHANGES to the team that was in defence.
		Loss of ball possession	When the attacking team loses the ball possession.
	Defensive	Regain the ball possession	When the defensive players regain the ball possession.
		Earn a foul, win a corner or throw-in	When the match is stopped due to a foul, corner or throw-in and the possession of the ball CHANGES to the team that was in defence.
		Commit a foul, give away a corner or throw in	When the match is stopped due to a foul, corner or throw-in; the team that was attacking KEEPS possession of the ball.
		Ball possession of the opponent	When the defensive players do not regain the ball possession.
		Take a shot at own goal	When the defensive team takes a shot at their own goal, and (a) takes a goal, (b) the goalkeeper makes a save, (c) the ball touches one of the goalposts or the crossbar.

Chart 2. The scoring values to rate each Creative Tactical Actions as per FUT SAT.

Components and values considered for the calculation of the Tactical Performance Index

Components	Values		Values
1) Performance of the Principle (PP)			
Yes	1		
No	0		
2) Quality of Principle Performance (QP)			
Successful	10		
Unsuccessful	5		
3) Place of Action in the Game Field (PA)			
- Offensive Midfield		- Defensive Midfield	
Offensive Tactical Actions	2	Defensive Tactical Actions	2
Defensive Tactical Actions	1	Offensive Tactical Actions	1
4) Action Outcome (AO)			
- Offensive		- Defensive	
Shoot at goal	5	Regain ball possession	5
Keep possession of the ball	4	Earn a foul, win a corner or throw-in	4
Earn a foul, win a corner or throw-in	3	Commit foul, give away a corner or throw-in	3
Commit a foul, give away a corner or throw-in	2	Ball possession of the opponent	2
Loss of ball possession	1	Take a shot at own goal	1

2) An Expert Rater Based Approach in which 'Identifying of Gaps' and 'Off the Ball Movements' field organizations are used as depicted in Figure 2 and Figure 3 respectively then scored by independent raters on the scale of 1-10 as shown in the Chart 3 and Chart 4 below. The scores are given for Originality (Statistically Rare Action), and Flexibility (Diversity in Situations) (Memmert & Roth, 2007).

Chart 3. The scaling for 'Identifying of Gaps'.

Originality of solutions to the situation (using gaps or passing)	Flexibility in the solutions to the situation (using gaps or passing)	Scaling	Anchor examples
Way above average (very unusual)	Two or more (different, original actions)	10	The child demonstrated different, highly unusual solutions to the situations. The gaps and passes found were absolutely unique
Way above average (unusual)	Two or more (different, original actions)	9	The child demonstrated different, unusual solutions to the situations. The finding of gaps or playing of passes was unique
Above average (rare)	Two (different, original/ rare actions)	8	The child demonstrated different, still unusual solutions to the situations. The gaps and passes found were very rare
Average (rather rare)	Two (different, rare actions)	7	The child demonstrated two different solutions to the situations that were not unusual, but still very rare. The gaps and passes found were very surprising
Average (quite rare)	Two (different, rare/ new actions)	6	The child demonstrated two different solutions to the situations, which were not unusual, but rare. The gaps and passes found were surprising
Just below average (still new)	One (rare action)	5	The child demonstrated one solution to the situations that was not the usual standard, but which had already occurred. The gaps and passes found were still innovative
Just below average (very little new)	One (new action)	4	The child demonstrated one solution to the situations that was not the usual standard, but which had already occurred often. The gaps and passes found were still innovative
Below average (rather standard)	none	3	The child generally offered standard solutions to the situations that had been displayed often. The gaps and passes found were rarely innovative
Way below average (almost all standard)	none	2	The child almost exclusively offered standard solutions to the situations, which had all been displayed previously. The gaps and passes found were very rarely innovative
Way below average (only standard)	none	1	The child only offered standard solutions to the situations. The gaps and passes found were never new

Chart 4. The scaling for ‘Off the ball movements’

Originality of solutions to the situation (using gaps or passing)	Flexibility of the solutions to the situation (using gaps or passing)	Scaling	Anchor examples
Way above average (very unusual)	Two or more (different, original actions)	10	The child demonstrated different, highly unusual solutions to the situations. The optimal positions found in the given time were absolutely unique
Way above average (unusual)	Two or more (different, original actions)	9	The child demonstrated different, unusual solutions to the situations. The optimal positions found in the given time were absolutely unique
Above average (rare)	Two (different, original/rare actions)	8	The child demonstrated different, still unusual solutions to the situations. The optimal positions found in the given time were very rare
Average (rather rare)	Two (different, rare actions)	7	The child demonstrated two different solutions to the situations that were not unusual, but still rather rare. The optimal positions found in the given time were very surprising
Average (quite rare)	Two (different, rare/new actions)	6	The child demonstrated two different solutions to the situations, which were not unusual, but quite rare. The optimal positions found in the given time were surprising
Just below average (still new)	One (rare action)	5	The child demonstrated one solution to the situations that was not the usual standard, but which had already occurred. The optimal positions found in the given time were still innovative
Just below average (very little new)	One (new action)	4	The child demonstrated one solution to the situations that was not the usual standard, but which had already occurred often. The optimal positions found in the given time were still innovative
Below average (rather standard)	none	3	The child generally offered standard solutions to the situations, which had been displayed often. The optimal positions found in the given time rarely showed any innovation
Way below average (almost all standard)	none	2	The child almost exclusively offered standard solutions to the situations, which had all been displayed previously. The optimal positions found in the given time very rarely showed any innovation
Way below average (only standard)	none	1	The child only offered standard solutions only to the situations. The optimal positions found in the given time were never new

3) Another Rater based Protocol called ‘Creative Behavior Assessment in Team Sports’ measures the tactical actions under the classification of Attempts, Fluency and Versitality (Santos et al., 2017).

Statistical Technique to be Employed in Study

In order to compare the creative performances of individuals in different intensity zones. Repeated Measures ANOVA will be used at 0.05 level of significance.

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